REMARKS

The pending claims, claims 1-6 and 14-16, have been rejected as anticipated by or obvious over Kearney et al., the Examiner suggesting various clarifying amendments that would place the claims in condition for allowance. The Applicant is making herewith the amendments suggested by the Examiner and submits that all claims in the application are in condition for allowance. Such action is now requested.

The Examiner is encouraged to telephone the undersigned attorney to discuss any matter that would expedite allowance of the present application.

Respectfully submitted,

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MARKED-UP VERSION OF CLAIM AMENDMENTS

1. (Twice amended) Method for operating a multi-phase process that is chemical, physical, or both, in a vessel containing at least two different phases~~, each phase being a liquid, a gas or solid particles,~~ selected from the group consisting of a liquid phase, a gas phase and a solid phase, inside which vessel a fluid is distributed through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of a child generation, ~~whereby~~ wherein each channel of said child generation may in turn be a parent for channels in a successive child generation, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume.

4. (Twice amended) Method for operating a process that is chemical, physical, or both, in a vessel containing at least two different phases~~, each phase being a liquid, a gas, or solid particles,~~ selected from the group consisting of a liquid phase, a gas phase and a solid phase, throughout which vessel a fluid is distributed through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of the child generation, ~~whereby~~ wherein each channel of said child generation may in turn be a parent for channels in a successive child generation, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume, wherein said network is a self-affine network of channels, wherein each of the channels in the parent generation has a diameter d_j and a length l_j, and each of the channels in the child generation has a diameter d_{j+1} and a length l_{j+1}, wherein at least one of the ratios d_j/d_{j+1} and l_j/l_{j+1} is substantially

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constant for channels of successive generations running in parallel direction, wherein the ratio of lengths of channels in successive generations of said network is related to N by the formula, $N = (l_j/l_{j+1})^D$, wherein D is between 2 and 3.

6. (Twice amended) Method for scaling up a multi-phase process that is chemical, physical, or both, and that is carried out in a vessel containing at least two different phases selected from the group consisting of a liquid phase, a gas phase and a solid phase,, comprising the steps of:

building a small scale vessel;

distributing a fluid through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into about N channels of the child generation, wherein each of the channels in the parent generation has a diameter d_j and a length l_j and each of the channels in a child generation has a diameter d_{j+1} and a length l_{j+1}, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume;

determining optimal geometry and optimal values for the parameters, N, Δ and D, wherein the diameters or the lengths of channels in successive generations of said network, or both, are related to N by at least one of the following relationships: $N = (d_j/d_{j+1})^\Delta$ and $N = (l_j/l_{j+1})^D$, wherein Δ and D each represents an integer or a real positive number; and

subsequently building a large scale vessel having substantially the same geometry and parameters as the small scale vessel, and having a larger number of generations than the small scale vessel.

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<u>MARK-UP OF CLAIMS PENDING PRIOR TO THE PRECEDING AMENDMENT</u>

DELETED TEXT IS ENCLOSED IN SQUARE BRACKETS, AND INSERTED TEXT IS UNDERLINED.

1. Method for operating a <u>multi-phase</u> [chemical and/or physical] process <u>that is chemical, physical, or both,</u> in a vessel containing <u>at least two phases, each phase being</u> a liquid, a gas [and/or] or solid particles, in<u>side</u> which vessel a fluid is [introduced] <u>distributed</u> through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of [the] <u>a</u> child generation, whereby each <u>channel</u> of said child generation[s] may in turn be a parent [generation] for <u>channels in</u> a successive child generation, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume.

2. Method according to claim 1 in which said network is a self-affine network of channels, wherein each of the channels in the parent generation [have] <u>has</u> a diameter d_j and <u>a</u> length l_j, and each of the channels in the child generation [have] <u>has</u> a diameter d_{j+1} and <u>a</u> length l_{j+1}, wherein <u>at least one of</u> the ratios d_j/d_{j+1} and[/or the ratios] l_j/l_{j+1} [are] <u>is</u> substantially constant for channels of successive generations running in parallel direction [or in which method said network is a self-similar network which is a type of said self-affine network wherein the ratios d_j/d_{j+1} and l_j/l_{j+1} are substantially constant for channels of successive generations independent of their direction].

3. Method according to claim 2 wherein the [ratios of] diameters [and/or] <u>or the</u> lengths of channels in successive generations of said network<u>, or both,</u> are related to N by <u>at least one of the following relationships:</u>

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$N = (d_j/d_{j+1})^{\Delta}$, and[/or]

$N = (l_j/l_{j+1})^{D}$,

wherein Δ and D each represents an integer or a real positive number.

4. Method [according to claim 3] for operating a process that is chemical, physical, or both, in a vessel containing at least two phases, each phase being a liquid, a gas, or solid particles, throughout which vessel a fluid is distributed through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of the child generation, whereby each channel of said child generation may in turn be a parent for channels in a successive child generation, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume, wherein said network is a self-affine network of channels, wherein each of the channels in the parent generation has a diameter d_j and a length l_j, and each of the channels in the child generation has a diameter d_{j+1} and a length l_{j+1}, wherein at least one of the ratios d_j/d_{j+1} and l_j/l_{j+1} is substantially constant for channels of successive generations running in parallel direction, wherein the ratio of lengths of channels in successive generations of said network is related to N by the formula, $N = (l_j/l_{j+1})^{D}$, wherein D is between 2 and 3.

5. Method according to claim 1, in which said [chemical and/or physical] multi-phase process is selected from a group consisting of a fluidized bed process, a slurry process, an absorption process, a gas/liquid bubble column process, and an aeration process.

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6. Method for scaling up [chemical and/or physical processes which processes are] a multi-phase process that is chemical, physical, or both, and that is carried out in a vessel, comprising the steps of:

building a small scale vessel [in which vessel];

distributing a fluid [is introduced] through a hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into about N channels of the child generation, wherein each of the channels in the parent generation has a diameter d_j and a length l_j and each of the channels in a child generation has a diameter d_{j+1} and a length l_{j+1}, which network terminates in channel exits, such that said fluid is discharged from the channel exits substantially uniformly throughout the vessel volume; [and]

determining optimal geometry and optimal values for the parameters, N, Δ and D, wherein the diameters or the lengths of channels in successive generations of said network, or both, are related to N by at least one of the following relationships: $N = (d_j/d_{j+1})^{\Delta}$ and $N = (l_j/l_{j+1})^{D}$, wherein Δ and D each represents an integer or a real positive number; and

subsequently building a large scale vessel [in which said] having substantially the same geometry and parameters [are substantially the same] as the small scale vessel, and having a larger number of generations than the small scale vessel.

7. Vessel containing, inside, a hierarchical network of channels, said network comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of the child

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generation, whereby each channel of said child generation[s] may in turn be a parent [generation] for channels in a successive child generation, which network terminates in channel exits, wherein said network is a self-affine network of channels, wherein each of the channels in the parent generation [have] has a diameter d_j and a length l_j, and each of the channels in the child generation [have] has a diameter d_{j+1} and a length l_{j+1}, wherein at least one of the ratio[s] d_j/d_{j+1} and[/or] the ratio[s] l_j/l_{j+1} [are] is substantially constant for channels of successive generations running in parallel direction, [or in which vessel said network is a self-similar network which is a type of said self-affine network wherein the ratios d_j/d_{j+1} and l_j/l_{j+1} are substantially constant for channels of successive generations independent of their direction,] wherein the ratio of lengths of channels in successive generations of said network is related to N by $N = (l_j/l_{j+1})^D$, wherein D is a real number between 2 and 3, which network terminates in channel exits, such that fluid introduced into said network and exiting said channel exits, is distributed substantially uniformly throughout the vessel volume.

8. Vessel according to claim 7, wherein the ratio of diameters of channels in successive generations of said network is related to N by

$$[N = (l_j/l_{j+1})^D, \text{ and/or}]$$

$$N = (d_j/d_{j+1})^\Delta,$$

wherein Δ [and D] represents an integer or a real positive number.

[~~9. Vessel according to claim 8 wherein D is between 2 and 3.~~]

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10. Hierarchical network of channels comprising parent and child generations of channel formations, wherein substantially each channel in a parent generation is divided into N channels of the child generation, whereby each <u>channel</u> of said child generation[s] may in turn be a parent [generation] for <u>channels of</u> a successive child generation, which network terminates in channel exits, which said network is a self-affine network of channels, wherein each of the channels in the parent generation [have] <u>has</u> a diameter d_j and length l_j and each of the channels in the child generation [have] <u>has</u> a diameter d_{j+1} and length l_{j+1}, wherein <u>at least one of</u> the ratio[s] d_j/d_{j+1} and[/or] the ratio[s] l_j/l_{j+1} [are] <u>is</u> substantially constant for channels of successive generations running in parallel direction<u>,</u> [or which network is a self-similar network which is a type of said self-affine network wherein the ratios d_j/d_{j+1} and l_j/l_{j+1} are substantially constant for channels of successive generations independent of their direction and] wherein the ratios of diameters [and/]or lengths of channels in successive generations of said network are related to N by <u>at least one of the following formulas:</u>

$$N = (d_j/d_{j+1})^{\Delta}, \text{ and[/or]}$$

$$N = (l_j/l_{j+1})^{D},$$

wherein Δ represents an integer or a real positive number and wherein D is a real number between 2 and 3.

[~~11. Network according to claim 10, wherein D is between 2 and 3.~~]

12. Network according to claim 10 wherein at least one material is present near the exits of said network [and/or said material is present] <u>or</u> as a coating on at least part of the inner surface of said network <u>or both</u>, which material is capable of chemical[,] [and/]or physical interactions<u>, or both,</u> with fluids <u>passing by the material</u>.

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13. Network according to claim 10 which is provided with means for obtaining a gradient in the dimensions of the respective exits.

(New claims 14-18 are also added, shown in the main body of the Amendment.)

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